Current Chemistry Letters 9 (2020) 143–150

Contents lists available at GrowingScience

Current Chemistry Letters

homepage: www.GrowingScience.com

Starch functionalization of trimetallic W-Mg-Al oxide for oxidative desulphurisation of dibenzothiophene

Melody Kimi[a*], Zainab Ngaini[b] and Sinin Hamdan[c]

[a]*Centre for Pre-University Studies, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia*
[b]*Department of Chemistry, Faculty of Science and Resource Technology, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia*
[c]*Department of Mechanical Engineering, Faculty of Engineering, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia*

C H R O N I C L E

Article history:
Received October 30, 2019
Received in revised form
November 21, 2019
Accepted January 10, 2020
Available online
January 10, 2019

Keywords:
Oxidative desulphurization
Dibenzothiophene
Trimetallic oxide
Starch
Immobilisation

A B S T R A C T

A novel trimetallic W-Mg-Al oxide composites immobilised onto starch were synthesized via sol-gel method. W-Mg-Al oxide composites were synthesized by first preparing WO_3 using incipient wetness method, followed by immobilising onto $MgO\text{-}Al_2O_3$ support using starch as binder. The effects of starch addition on the crystal properties and morphology were investigated by X-ray diffraction (XRD), Fourier Transform Infrared (FT-IR) spectroscopy and Scanning Electron Microscopy (SEM). In the presence of hydrogen peroxide and acetic acid as oxidant system, W-Mg-Al oxide starch composites exhibited higher catalytic performances for oxidative desulphurisation (ODS) of dibenzothiophene (DBT) at 95% compared to W-Mg-Al oxide composites. The catalytic activity observed could be correlated to the distribution of active phases on starch as well as the higher crystallinity of the metal oxide composites.

1. Introduction

Sulphur-containing compounds in transportation fuels are one of the most undesirable contaminants, because they are converted to toxic sulfur oxides (SO_x) through combustion. Studies have been conducted to reduce the sulphur content in oil fractions due to environmental regulation and concerns.[1] Removal of sulphur-rich fuels such as benzothiophene and dibenzothiophene is crucial in the refinement of fossil fuels.[2] Oxidative desulphurisation (ODS) operates in mild conditions overcomes the shortcoming of conventional hydrodesulfurisation (HDS) process which required high temperature and cost. Moreover, HDS is ineffective to remove aromatic sulphur compounds due to steric hindrance.[3]

In the ODS system, the thiophene compounds is oxidised to sulphoxides and/or sulphones using suitable oxidants such as hydrogen peroxide with acetic acid.[4] High oxidant-to-sulphur ratio is required to oxidise sulphur compounds. The amount of oxidant used is reduced with the addition of catalyst.

* Corresponding author.
E-mail address: kmelody@unimas.my (M. Kimi)

doi: 10.5267/j.ccl.2020.1.001